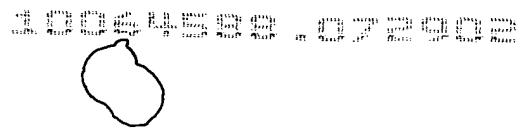




## Claims

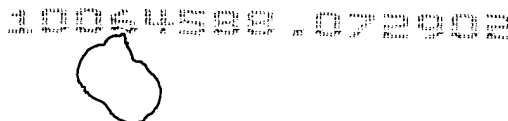
- [c1] A ceramic film for reducing leakage of a selected gas through an outer surface of a porous ceramic substrate structure having an interior portion formed with the outer surface; the substrate being porous to at least one selected gas, the ceramic film comprising:
- a first ceramic coating layer for adherence to at least a portion of the outer surface of the ceramic substrate structure; the first ceramic coating being initially applied in a suspension state, the first ceramic coating suspension having a desired level of viscosity for substantially uniform application to the surface; and being formed with a ceramic electrolyte powder and at least one organic additive; and
  - a second ceramic coating layer for adherence to at least a portion of the outer surface of the ceramic substrate structure following application of the first ceramic coating and subsequent to a drying process of the first ceramic coating; the second ceramic coating being initially applied subsequent to application of the first ceramic coating; the second ceramic coating being initially applied in a suspension state having a lower viscosity relative to the viscosity of the suspension used for the first coating.
- [c2] The invention of claim [Claim Reference] further including a third ceramic coating layer adhered to at least a ~~portion~~ of the outer surface of the ceramic substrate structure following application of the second ceramic coating; the third ceramic coating being initially applied subsequent to applying the second ceramic coating; the third ceramic coating being initially applied as a suspension having a lower viscosity relative to the viscosity of the suspension for the second ceramic coating.
- [c3] The invention of claim [Claim Reference] wherein a vacuum is applied to the ceramic substrate structure on a side directionally opposite to the first ceramic coating in relation to the outer surface; the vacuum is formed during the application of the ceramic coating to the ceramic substrate structure while the ceramic coating is in a suspension state.

- [c4] The invention of claim [Claim Reference] wherein the first ceramic coating comprises toluene, ethanol, butyl benzyl phthalate, polyvinyl butyral, and a powder of  $\text{Ce}_{0.8}\text{Gd}_{0.2}\text{O}_2$  (CGO).
- [c5] The invention of claim [Claim Reference] wherein the ceramic coating layers are applied to the ceramic substrate by dipping a portion of the ceramic substrate into the desired suspension.
- [c6] The invention of claim [Claim Reference] wherein the viscosity of the ceramic coating suspension is in the range of 50–200 cPs.
- [c7] A method of manufacturing a ceramic film for reducing leakage of a selected gas through an outer surface of a porous ceramic substrate structure having an interior portion formed with the outer surface; the substrate being porous to at least one selected gas comprising:
- applying a first ceramic coating layer to at least a portion of the outer surface of the ceramic substrate structure; the first ceramic coating being initially applied in a suspension state, the first ceramic coating suspension having a desired level of viscosity for substantially uniform application to the surface; and being formed with a ceramic electrolyte powder and at least one organic additive; and
  - applying a second ceramic coating layer to at least a portion of the outer surface of the ceramic substrate structure following application of the first ceramic coating and subsequent to a drying process of the first ceramic coating; the second ceramic coating being initially applied subsequent to application of the first ceramic coating; the second ceramic coating being initially applied in a suspension state having a lower viscosity relative to the viscosity of the suspension used for the first coating.
- [c8] The method of claim [Claim Reference] further including applying a third ceramic coating layer to at least a portion of the outer surface of the ceramic substrate structure following application of the second ceramic coating; the third ceramic coating being initially applied subsequent to applying the second ceramic coating; the third ceramic coating being initially applied as a



suspension having a lower viscosity relative to the viscosity of the second ceramic coating.

- [c9] The method of claim [Claim Reference] wherein a vacuum is applied to the ceramic substrate structure on a side directionally opposite to the first ceramic coating in relation to the outer surface; the vacuum is formed during the application of the ceramic coating to the ceramic substrate structure while the ceramic coating is in a suspension state.
- [c10] The method of claim [Claim Reference] wherein the first ceramic coating comprises toluene, ethanol, butyl benzyl phthalate, polyvinyl butyral, and a powder of  $\text{Ce}_{0.8}\text{Gd}_{0.2}\text{O}_2$  (CGO).
- [c11] The method of claim [Claim Reference] wherein the ceramic coating layers are applied to the ceramic substrate by dipping a portion of the ceramic substrate into the desired suspension.
- [c12] The method of claim [Claim Reference] wherein the viscosity of the ceramic coating suspension is in the range of 50–200 cPs.
- [c13] A coated ceramic apparatus comprising:
- a porous ceramic substrate structure having an interior portion formed with the outer surface; the substrate being porous to at least one selected gas;
  - a first ceramic coating layer for adherence to at least a portion of the outer surface of the ceramic substrate structure; the first ceramic coating being initially applied in a suspension state, the first ceramic coating suspension having a desired level of viscosity for substantially uniform application to the surface; and being formed with a ceramic electrolyte powder and at least one organic additive; and
  - a second ceramic coating layer for adherence to at least a portion of the outer surface of the ceramic substrate structure following application of the first ceramic coating and subsequent to a drying process for the first ceramic coating; the second ceramic coating being initially applied subsequent to application of the first ceramic coating; the second ceramic



coating being initially applied in a suspension state having a lower viscosity relative to the viscosity of the suspension used for the first coating;

whereby the ceramic coating layers substantially prevent leakage of the selected gas through the outer surface from the interior portion of the ceramic substrate structure.

[c14] The apparatus of claim [Claim Reference] further including a third additional ceramic coating layers adhered to at least a portion of the outer surface of the ceramic substrate structure following application of the second ceramic coating; the third additional ceramic coatings being initially applied subsequent to applying the second ceramic coating; the third additional ceramic coatings being initially applied as a suspension having a lower viscosity relative to the viscosity of the second ceramic coating.

[c15] The apparatus of claim [Claim Reference] wherein a vacuum is applied to the ceramic substrate structure on a side directionally opposite to the first ceramic coating in relation to the outer surface; the vacuum is formed during the application of the ceramic coating to the ceramic substrate structure while the ceramic coating is in a suspension state.

[c16] The apparatus of claim [Claim Reference] wherein the first ceramic coating comprises toluene, ethanol, butyl benzyl phthalate, polyvinyl butyral, and a powder of  $\text{Ce}_{0.8}\text{Gd}_{0.2}\text{O}_2$  (CGO).

[c17] The apparatus of claim [Claim Reference] wherein the ceramic coating layers are applied to the ceramic substrate by dipping a portion of the ceramic substrate into the desired suspension.